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(54) **Methods and arrangements for handling unreliable scheduling grants in a telecommunication network**

VERFAHREN UND ANORDNUNGEN ZUR ABWICKLUNG VON UNZUVERLÄSSIGEN ABLAUFPLANUNGSGEWÄHRUNGEN IN EINEM TELEKOMMUNIKATIONSNETZ

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- **"3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Physical channels and mapping of transport channels onto physical channels (FDD) (Release 6)", 3GPP STANDARD; 3GPP TS 25.211, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, no. V6.3.0, 1 December 2004 (2004-12-01), pages 1-56, XP050366695,**

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EP 2 448 199 B1

Description

TECHNICAL FIELD

[0001] The present invention relates to communication systems in general, specifically to methods and arrangements for handling unreliable scheduling grants in a WCDMA-communication system.

BACKGROUND

[0002] In WCDMA enhanced uplink the Node B sends scheduling commands to the user equipments (UE) at every Transmission Time Interval (TTI), which at present can be either 2 ms or 10 ms. Each user equipment maintains a serving grant (SG) by increasing or decreasing its transmitted bit rate as dictated by the scheduling grants received from the network. This change in the transmitted bit rate is in turn achieved by applying the selection of the Transport Format Combination (TFC) in the user equipment.

[0003] A scheduling grant or scheduling grant message provides an indication from e.g. the Node B of both serving and non-serving radio link sets to the user equipment about the maximum amount of uplink resources it may use. The scheduling grants are sent once per Transmission Time Interval or even less frequently. The serving grant (SG) represents the uplink resources that the user equipment is presently utilizing on the serving radio link set i.e. bit rate.

[0004] The following two types of grant channels have been specified [1] [2] in the standard according to prior art: Enhanced Relative Grant Channel (E-RGCH) and Enhanced Absolute Grant Channel (E-AGCH). The E-RGCH channel is transmitted by a serving radio link set (RLS) as well as by one or several non-serving RLS:s. This is shown in Figure 1. The serving RLS transmits the commands "DOWN", "UP", and "HOLD", which may correspond, e.g., to -1, +1, and 0 respectively. On the other hand, non-serving RLS:s transmits either "DOWN" or "HOLD", which may correspond to +1 or 0 respectively. Only the serving RLS uses the E-AGCH channel to send the absolute grant, which corresponds to the maximum allowed bit rate for the user equipment.

[0005] In soft handover (SHO) the user equipment receives absolute and/or relative grants from the serving RLS, whereas the non-serving RLS sends only the relative grant. If any of the relative grants is "DOWN", the user equipment estimates its New SG as follows according to prior art:

$$\text{New SG} = \text{last bit rate used} - \delta$$

[0006] The δ in the above equation may correspond to the user equipment transmit power or bit rate. If none of the relative grants is "DOWN" then the New SG will be according to the absolute/relative grants received from the serving RLS.

[0007] The existing solutions according to prior art imply at least two problems:

Firstly, not all scheduling grants are reliable. There is always a risk that the power of the grant is such that, e.g., a "DOWN" grant can be erroneously treated as a "HOLD" grant, which in turn results in too much interference in the system.

[0008] Secondly, the network is not aware whether the scheduling grants that it is transmitting are reliable or not.

[0009] Therefore, there is a need for solutions providing handling of unreliable scheduling grants at the user equipment and for reducing the occurrence of unreliable grants in the network.

[0010] GB2402021 discloses methods and arrangements for controlling the data transmission rate between a mobile phone and a base station, which is achieved by a closed-loop control of the data communication rate where a base station communicates to the mobile phone absolute rate values and frequent differential rate corrections that the mobile phone shall apply and initiates periodic resettings of the rate to a predetermined common reference data transmission rate. The disclosure mentions that erroneously received rate commands will lead to a fast break down of the data rate control scheme. However, GB2402021 does not provide any other disclosure than that the rate values and the differential rate corrections are always considered to be received in a reliable way.

[0011] The conference paper "Adjustment loop transmit power control during soft handover in CDMA cellular systems" by Kojiro Hamabe discloses how to deal with reception errors of fast closed-loop transmit power control (TPC) commands in the downlink by introducing adjustment loop TPC, in which base stations gradually change the transmit power so that the transmit power difference between base stations is reduced without disturbing fast closed-loop TPC.

SUMMARY

[0012] It is an object of the present invention to provide methods and arrangements for handling unreliable scheduling grants in a communication system, more specifically it is an object of the present invention to enable a user equipment to estimate new serving grants based on reliable and unreliable scheduling grants and to enable a communication network to handle unreliable scheduling grants.

[0013] It is a further object of the present invention to enable a communication network to improve the reliability of the scheduling grants.

[0014] These and other objects are achieved in accordance with the attached claims.

[0015] Briefly, according to the invention a user equip-

ment detects that a received scheduling grant is unreliable and adjust its serving grant based on that information. According to a specific embodiment, the user equipment is also able to report continuously received unreliable grants as an event to the network, allowing the network to adapt its operation to reduce the unreliable grants. The term continuously is used in the sense that a plurality of consecutive received scheduling grants are unreliable.

[0016] The invention proposes a new method in a user equipment in response to receiving unreliable scheduling grants. The method generally includes: the user equipment detects unreliable received relative scheduling grants; the user equipment takes appropriate action, i.e. adjust its serving grant to prevent interference.

[0017] Optionally the user equipment reports an event to the network if grants are continuously received unreliably. Subsequently, and optionally, the network adjusts the power offset of the grant channel and/or the downlink load of the corresponding cell.

[0018] Advantages of the present invention include:

- The unreliable scheduling grants will be detected by the user equipment and such grants shall not be taken into account during soft handover combining process.
- The user equipment does not transmit at a rate higher than the network can tolerate, preventing bad uplink reception quality.
- The user equipment transmits at a rate, which in some scenario can allow the base station to detect that it is transmitting an unreliable grant.
- The network is able to know if the scheduling grants are received reliably or not.
- The network will be able to take some radio resource management (RRM) actions, which will eventually alleviate the problem of transmitting unreliable grants.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The invention, together with further objects and advantages thereof, may best be understood by making reference to the following description taken together with the accompanying drawings, in which:

Fig. 1 illustrates the transmission of scheduling grants in E-DCH;
Fig. 2 illustrates unreliabile power regions for relative scheduling grants;
Fig. 3 is a schematic flow diagram of an embodiment of a method according to the invention;
Fig. 4 is a schematic flow diagram of another embodiment of a method according to the invention;
Fig. 5 is a schematic flow diagram of a further embodiment of a method according to the invention;
Fig. 6 is an embodiment of arrangements according to the invention.

ABBREVIATIONS

[0020]

UE	User Equipment
UL TPC	Uplink Transmit Power Control
E-RGCH	Enhanced Relative Grant Channel
E-AGCH	Enhanced Absolute Grant Channel
TTI	Transmission Time Interval
SG	Serving Grant
TFC	Transport Format Combination
RLS	Radio Link Set
E-DCH	Enhanced Dedicated Channel
WCDMA	Wideband Code Division Multiple Access
RRM	Radio Resource Management
3GPP	3rd Generation Partnership Project
RNC	Radio Network Controller
SHO	Soft Handover

DETAILED DESCRIPTION

[0021] A first problem with prior art is that the user equipment (UE) does not carry out any reliability check of the received scheduling grants, which might cause the UE to misinterpret the grants especially for soft handover. In other words, some grant messages received by the UE can be unreliable. This could happen due to number of reasons: noisy link, lower transmit power on the grant channel due to inappropriate power setting on the grant channels, bad UE receiver performance, etc.

[0022] For instance, in case a "DOWN" grant is interpreted as "HOLD", the user equipment will follow the scheduling grant from the serving RLS, which may lead to excessive interference at the non-serving or neighboring cells. On the other hand, detection of "HOLD" as "DOWN" will lead to throughput loss. It is important to note that the base station does not have any information about the load situation in the neighboring cells implying that all the base stations send their respective scheduling grants independently.

[0023] The false detection of "DOWN" as "HOLD" is a more extreme situation since there will be an impact on the uplink interference. However, there is also throughput loss if "UP" (from the serving RLS) is interpreted as "HOLD" or "HOLD" (from neighboring cell) is interpreted as "DOWN". Similarly, the network or base stations will experience more interference if the UE treats "HOLD" (from the serving RLS) as "UP".

[0024] Another problem with the current solution is that the communication network is not aware whether the transmitted grants are reliable or not, i.e. there is no mechanism by which the network can be informed that the received grants are unreliable. This means that a

plurality of unreliable grants could be continuously transmitted without any corrective action by the network, resulting in excessive interference in the neighboring cells.

[0025] Basically, the present invention addresses the handling of unreliable scheduling grants in a user equipment and a network. The user equipment identifies such unreliable grants and treat them according to one of the possible embodiments stated below in the detailed description while the network then assures reliability by help of one of the embodiments as stated below in the detailed description. The solution according to the present invention is applicable but not limited for single link and particularly advantageous in soft handover scenarios.

[0026] The invention will be described in the context of a user equipment UE communicating with a serving radio link set RLS and receiving scheduling grants from both the serving RLS and at least one non-serving RLS, as is illustrated in Fig. 1.

[0027] With reference to Fig. 1 a basic situation in which the present invention can be applicable is that a user equipment (UE) receives a plurality of relative scheduling grants from the serving RLS and at least one non-serving RLS. The UE needs to detect if any of the relative grants from the non-serving RLS is reliable or not. One indication of an unreliable scheduling grant is that the received power from the grants channel lies in one of the unreliable power regions or intervals δ_1,δ_2 indicated in to Fig. 2.

[0028] Upon detection of at least one unreliable scheduling grant the UE needs to take appropriate action to dynamically adapt its serving grant (SG) such that the neighboring cells do not receive excessive interference. In the following a number of embodiments for this adjustment will be described.

[0029] Basically, the UE needs to detect if any of the relative grants received from the non-serving RLS is reliable or not. Unreliability can be detected, e.g., if the received power from the grant channel lies in an unreliable region or power interval δ_1,δ_2, as illustrated in Fig. 2. The region is unreliable in the sense that for a grant with a received power within that interval it is difficult to distinguish a "DOWN" grant from a "HOLD" grant, and to distinguish a "HOLD" grant from an "UP" grant. If any of the relative grants is unreliable the UE adapts the serving grant (SG) such that the neighboring cells don't receive excessive interference. In other words, the UE dynamically adapts its SG.

[0030] With reference to Fig. 3, according to a basic embodiment of a method, a user equipment detects S1 that at least one received scheduling grant is unreliable, subsequently the UE evaluates or interprets S2 the unreliable grant(s) and estimates S3 a new serving grant based at least on the interpretation.

[0031] According to a specific embodiment, if the user equipment receives a plurality of consecutive unreliable scheduling grants it reports S4 an event to the network, i.e. the radio network controller.

[0032] According to the preferred embodiment, the user equipment interprets or evaluates S2 the detected unreliable scheduling grants, and estimates S3 the new serving grant based on that interpretation.

[0033] According to an alternative embodiment, a scheduling grant is detected S 1 as unreliable if the received power is within a predetermined power interval or region. There is a first such unreliable region δ_1 between the "DOWN" command and the "HOLD" command, and second region δ_1 between the "HOLD" command and the "UP" command.

[0034] In the following, a number of specific embodiments concerning the evaluation or interpretation S2 of the unreliable scheduling grants and the estimation S3 of new serving grants will be described.

[0035] Generally, the user equipment interprets the unreliable scheduling grant based on some criteria, and estimates the new serving grant based on that interpretation. Also, the interpreting step can comprise ignoring an unreliable grant, thus not using the unreliable grant in the estimation of the new serving grant. Further, the interpretation can be aided by some additional measurements. However, the collective idea of the embodiments is that the UE detects that a scheduling grant is unreliable, and takes this into consideration when estimating the new serving grant.

[0036] According to a preferred embodiment of the present invention, the UE evaluates or interprets S2 received unreliable relative scheduling grants as "HOLD" when estimating S3 the new serving grant. This means that the UE shall follow other reliable grant(s). In case all the relative grants are unreliable the UE shall treat all the grants are "HOLD", this means the serving relative grant will not change. Possible combinations of relative grants are listed below:

"UP" and "Unreliable" --> "UP"
"DOWN" and "Unreliable" --> "DOWN"
"HOLD" and "Unreliable" --> "HOLD"
"Unreliable" and "Unreliable" --> "HOLD"

[0037] According to another specific embodiment of the present invention, the UE disregards the relative scheduling grant from non-serving RLS when at least one relative grant is unreliable. The evaluating step S2 in this case means that the unreliable relative scheduling grant is determined never to have been received. This means that the UE maintains the last serving grant for which the corresponding relative grants all were reliable. Hence, the UE estimates S3 its serving grant (SG) as follows:

$$SG(k) = SG(m)$$

where k denotes the current TTI, and m is the last TTI, when the UE has received reliable relative grants from all the RLS. Possible combinations of grants comprise:

"UP" and "Unreliable" --> "HOLD"
"DOWN" and "Unreliable" --> "HOLD"
"HOLD" and "Unreliable" --> "HOLD"
"Unreliable" and "Unreliable" --> "HOLD"

[0038] However, the embodiment described above does not provide precautions for the case that the UE still transmits at a too high data rate if one of the RLS wants to decrease the transmitted bit rate. Hence, a further specific embodiment is a further elaboration of this embodiment, that in case of one or more unreliable grants, the UE only follows the "DOWN" grant or a new serving grant if that grant is lower than the previous grant:

$$SG\ (k) = \min\ \{SG\ (m),\ G_{serv_cell}(k)\}$$

where G_{serv_cell} denotes the scheduling grant (relative or absolute) received from the serving cell in the current TTI. Possible combinations of grants comprise:

"UP" and "Unreliable" --> "HOLD"
"DOWN" and "Unreliable" --> "DOWN"
"HOLD" and "Unreliable" --> "HOLD"
"Unreliable" and "Unreliable" --> "HOLD"

[0039] It is still another specific embodiment that the network sends uplink interference thresholds, i.e. the user equipment UE receives such thresholds, common for all cells or different for different cells, for the neighboring cells in the neighboring cell lists. When unreliable scheduling grant(s) is/are detected S1, the UE then measures the path loss to the neighboring cell and estimate the UL interference. The UE then adjusts its transmit power using the TFC selection in order to keep the UL interference below the threshold set by the network. In this way, the interference on the neighboring cells can be avoided. This method has the advantage that there is a maximum interference limit that the UE can cause to any neighboring cell even if the grant signaling is totally unreliable. Even if the downlink is totally gone for a while, the UE will be able to limit the interference caused. A cell that is not in the active set is protected just before it is about to be added to the active set and becomes a non-serving or serving cell. Further, the UE may also be able to transmit at higher rate, unlike the previous embodiments, if the estimated interference is low. The idea of setting uplink interference thresholds to avoid interference can also be applied to other types of uplink channels, e.g. simple DCH.

[0040] This embodiment can be used in combination with all the previous embodiments of the invention.

[0041] According to yet another specific embodiment of a method according to the invention, it is possible for the UE to utilize other information for evaluating or interpreting an unreliable relative scheduling grant from the network.

[0042] In E-DCH transmission fast power control is used. If radio links are unreliable, the UE may, according to a specific embodiment, also utilize the UL TPC commands, which are sent on the downlink, i.e. from the node B to the UE, to assist the interpreting of relative grants from the non-serving RLS, i.e. the UL TPC commands can indicate the quality of the uplink. An UL TPC command "DOWN" implies that the uplink of the corresponding radio link is good and vice versa. If UL TPC command is "DOWN" (i.e. good uplink) and the scheduling grant is unreliable, then the UE can interpret the scheduling grant as "HOLD". Hence, the UE can then simply follow the grant from the serving cell. Similarly, if TPC command is "UP" (i.e. bad uplink) and the scheduling grant is "unreliable", then the UE can consider the scheduling grant as "DOWN".

[0043] When assuming '1' as logical value for the "DOWN" UL TPC command and '0' as the logical value for the "UP" UL TPC command and when denoting

$$TPC_{UL_TTI} = \begin{cases} 1 & ; \text{ UP Command} \\ 0 & ; \text{ DOWN Command} \end{cases},$$

the algorithm can be summarized as follows:
If the received 'Relative Grant' R_g is unreliable then

$$R_g = (-1) \cdot TPC_{UL_TTI}\ \mathrm{R_g} = \text{-}1\ \mathrm{x}\ \mathrm{TPC_{UL_TTI}}.$$

Note that R_g=(-1) means "DOWN" and R_g=0 means "HOLD".

[0044] TPC_{UL_TTI} is based on the combined decisions of all the TPC_{UL} commands received during one TTI (2ms or 10ms), e.g. if the majority of TPC_{UL} are UP, then TPC_{UL_TTI} is UP and vice versa.

[0045] This solution is feasible in case the TPC commands are also detected reliably. According to the document 3GPP TS25.101 "UE radio transmission and reception (FDD)" [6] issued by the 3rd Generation Partnership Project the UE is required to detect if the received TPC commands are reliable or not. However, there is no indication to the network if the TPC commands are received reliably or not. Therefore, it must also be proposed that the UE does an event reporting in case a number M of TPC commands are unreliable during a certain time (the same principle as for unreliable grants described above). Consequently, the network can increase the power offsets on the DL DPCCH or reduce the downlink load to ensure that the subsequent UL TPC commands are also received reliably. Currently the UE reports an out-of-sync, which is an extreme situation where the link is about to be disconnected.

[0046] The above-described examples comprise the case for two received scheduling grants. However, the same principle applies to cases with more than two

scheduling grants.

[0047] The above-described embodiments act so as to enable the user equipment to properly evaluate unreliable scheduling grants, but do not give any indication on how to reduce the occurrence of unreliable grants. Consequently, network measures are necessary in case of unreliable grants. This is necessary in order to reduce the number of unreliable transmitted scheduling grants and consequently reducing the unnecessary interference in the system.

[0048] With reference to Fig. 4, according to a basic embodiment of a method of the invention, the network receives S10 a report in the event of continuously received unreliable scheduling grants from a user equipment, and initiates S11 an adjustment of power offsets for the scheduling grant channels in the system.

[0049] If received scheduling grants in a soft handover scenario are unreliable, the UE can use the possible solutions as explained above for the user equipment to ensure that the neighboring cells are not interfered. However, it is also important that the network is informed if the scheduling grants are continuously transmitted unreliably. This will allow the network to take some radio resource management (RRM) related actions.

[0050] One proposed embodiment of this solution is that if N scheduling grants are received unreliably over a measurement period of T_1 ms, then this event (Ug) is reported S4 to and received at S10 a serving network unit e.g. the radio network controller (RNC) using RRC signaling. The network configures the values of the parameters (N and T_1) using RRC signaling. If the network receives S10 the event (Ug) from the UE, it takes some radio resource management measures S11 to ensure that the UE receives the subsequent scheduling grants reliably. For example, the network can, according to a specific embodiment, increase the power offsets on the grant channel or it can, according to another embodiment, reduce the downlink load so that downlink interference is decreased and eventually the grant commands become less noisy.

[0051] According to prior art a node, e.g. Node B, can be unaware that the scheduling grants it is transmitting are unreliably received. It would therefore be beneficial to prevent the actual transmission of unreliable grants, or detect them before they even arrive at the user equipment.

[0052] Therefore, according to a basic embodiment of a method, with reference to Fig. 5, comprises the Node B detecting S20 unreliably transmitted scheduling grants and subsequently requesting S21 the serving unit e.g. radio network controller RNC to review the power offset for the grant channels.

[0053] More specifically, one or more unreliable scheduling grants may in some cases result in UE transmitting either at lower or higher data rates than expected by the radio base station. For example, the combination of reliable "UP" and unreliable "DOWN" would lead to data rate that is higher than expected at the base station that transmits unreliable "DOWN"-command. This unexpected data rate can be detected S20 at the base station or Node B, which in turn can request S21 the RNC to review the power offsets of the scheduling grant channels. The RNC in turn can increase the power offset or take any appropriate action, e.g. reduce downlink load.

[0054] The impact of unreliable grants is more critical in soft handover situations as this causes the interference at the neighboring base stations. But it is also important for the UE to check the reliability of the command in single link scenarios. In the single link case there is a risk that, on the one hand, the serving cells may receive too much interference and, on the other hand, the resources may be under-utilized. In case of single link the UE simply treats an unreliable scheduling grant as "HOLD". This means the UE transmits according to the last reliable grant using the same principle as described above for the user equipment. In single link case this means:

"Unreliable = HOLD"

[0055] The UE may also utilize the UL TPC commands, as described previously, to assist the reliable detection of at least the relative scheduling grant from the serving RLS.

[0056] In case N scheduling commands are detected unreliably during a time period of T_1 ms, the UE can also report this event to the network, which in turn can take some RRM actions as stated in the paragraph above on reporting of unreliable grants and RRM-actions. It is also possible to use the base station power adjustments as described above.

[0057] Arrangements adapted for implementing the above-described methods will be described with reference to Fig. 6.

[0058] An embodiment of an arrangement in a user equipment according to the invention comprises a detection unit 11 for detecting unreliable received scheduling grants, an optional interpretation or evaluation unit 12 for evaluating or interpreting the unreliable received grants, and an estimation unit 13 for estimating or calculating a new serving grant for the user equipment UE based on the evaluation of the unreliable grants and possibly some other information as well. Optionally, the arrangement comprises a report unit 14 which is adapted to report an event to a serving unit of the network, e.g. radio network controller, if unreliable grants are received continuously at the user equipment UE.

[0059] According to a further embodiment, the arrangement comprises a unit for receiving uplink interference thresholds for neighboring cells in a neighboring cell list. The receiving unit is adapted to, in response to detection of unreliable grants, measure the path loss of the neighboring cell and adjust its transmit power.

[0060] Another specific embodiment comprises a unit for receiving UL TPC commands from a serving unit in

the network e.g. base station, and the interpretation unit 21 is adapted to interpret the detected unreliable grants based on the UL TPC commands.

[0061] For all the above-described embodiment of the arrangement in the user equipment, the detecting unit 11 can detect single received unreliable grants and/or multiple unreliable grants.

[0062] Also with reference to Fig. 6, an embodiment of a node, e.g. Node B, in a telecommunication system comprises a detection unit 50 for detecting transmitted unreliable scheduling grants, and a request unit 51 for requesting a serving unit, e.g. radio network controller, to review and possibly adjust the power offsets for the scheduling grants channels based on the detected unreliable transmitted scheduling grants.

[0063] Also with reference to Fig. 6, an embodiment of a serving unit, e.g. radio network controller, according to the invention comprises a receiving unit 40 for receiving event reports from user equipment and an initiating unit 41 for initiating radio resource managing (RRM) procedures in response to the received event report. Such RRM actions can include increasing power offsets on the grants channel, reducing downlink load, and/or removing the unreliable radio link or replacing it with a reliable radio link.

[0064] In summary, the user equipment UE needs to detect if any of the received scheduling grants RLS are unreliable. It is thus necessary to define different ways by which the user equipment could set its new serving grant (SG) in case one or more scheduling grants are unreliable. The user equipment reports for instance an event U_g to the network, e.g. the RNC, on the radio RRC signaling if N scheduling grants are unreliably received over a certain period of time. In case the network receives said Ug event, the network takes an appropriate measure, for example to increase the power offset of the corresponding grant channel. Another possibility is to reduce the downlink load in corresponding cell(s), thereby decreasing interference and improving detection of the scheduling grants by the UE. In certain scenarios, the node B can detect if it is transmitting unreliable grants or not. This detection could be based on the difference between the expected bit rate and the actually transmitted bit rate of the UE. The node B can then request the RNC to adjust power offsets of the grant channels.

[0065] The present invention thus describes new methods and arrangements for user equipment and network units in case the user equipment receives unreliable scheduling grants. The user equipment detects unreliable grants, takes appropriate actions and reports an event to the network, e.g. if grants are continuously received unreliably. The network adjusts the power offset of the grant channel and/or the downlink load of the corresponding cell.

[0066] The embodiments described above are merely given as examples, and it should be understood that the present invention is not limited thereto. Further modifications, changes, and improvements retaining the basic underlying principles disclosed and claimed herein are within the scope of the invention. It is also implied that the various methods and arrangements according to the invention can be combined with each other and other functionalities, without departing from the main inventive concept.

REFERENCES

[0067]

[1]. 3GPP TS 25.211"Physical channels and mapping of transport channels onto physical channels (FDD)"

[2]. 3GPP TS 25.214 "Physical layer procedures (FDD)".

[3]. 3GPP TS 25.302 "Services provided by the physical layer".

[4]. 3GPP TS 25.321 "MAC specifications".

[5]. 3GPP TS 25.331, "RRC protocol specifications".

[6]. 3GPP TS 25.101, "UE radio transmission and reception (FDD)".

Claims

1. A method in a user equipment in a telecommunication network for handling unreliable relative scheduling grants of relative scheduling grants comprising one of a HOLD command, an UP command and a DOWN command applicable in one of a single link and a soft handover scenario, the method **characterized by**
detecting (S1) at least one unreliable received relative scheduling grant comprising determining if the received power is within a predetermined interval, wherein any received relative scheduling grant not detected as unreliable is reliable;
interpreting (S2) any detected unreliable relative scheduling grant as HOLD; estimating (S3) a new serving grant based at least on the detection and the interpretation, the estimating (S3) comprising adapting the serving grant by following commands of reliable relative scheduling grants and by treating unreliable relative scheduling grants as HOLD.

2. The method according to claim 1, **characterized by** reporting (S4) an event to said telecommunication network on continuously received unreliable scheduling grants during a given period of time.

3. The method according to claim 2, **characterized by** reporting (S4) the event if a predetermined number

of unreliable scheduling grants have been received during the given period of time.

4. The method according to claim 1, **characterized by** the further steps of the user equipment receiving uplink interference thresholds for neighboring cells in a neighboring cells list; and in response to at least one detected unreliable received scheduling grant:

measuring the path loss to the neighboring cell and estimating UL interference, and
adjusting transmit power using the TFC selection to keep the interference below the uplink interference threshold.

5. The method according to any of claims 1 to 3, **characterized by** receiving UL TPC commands from a base station and interpreting (S2) the at least one unreliable received grant based on the received UL TPC commands.

6. The method according to claim 5, **characterized by** interpreting (S2) an unreliable received scheduling grant as HOLD if the UL TPC command is DOWN, whereby the user equipment can follow the grant from the serving cell.

7. The method according to claim 5, **characterized by** interpreting (S2) an unreliable received scheduling grant as DOWN if the UL TPC command is UP.

8. The method according to claim 5, **characterized by** interpreting (S2) said at least one unreliable received scheduling grant according to:

$$R_g = -1 x TPC_{UL_TTI}$$

where R_g=interpreted unreliable grant, and TPCUL=1 for UP command and TPCUL=0 for DOWN command. TPC_{UL_TTI} is based on the combined decisions of all the TPC_{UL} commands received during one TTI (2 ms or 10 ms), e.g. if majority TPC_{UL} are UP, then TPC_{UL_TTI} is UP and vice versa.

9. The method according to claim 1, **characterized in that** said predetermined interval is an unreliable power region.

10. The method according to claim 9, **characterized in that** said unreliable region is defined by a first and a second threshold value.

11. The method according to any of the preceding claims, **characterized by** detecting a plurality of unreliable received scheduling grants.

12. The method according to any of claims 1-11, **characterized by** detecting only one unreliable received scheduling grant.

13. An arrangement in a user equipment in a telecommunication network for handling unreliable relative scheduling grants of relative scheduling grants comprising one of a HOLD command, an UP command and a DOWN command applicable in one of a single link and a soft handover scenario, **characterized by** means for detecting (11) at least one unreliable received scheduling grant, said means for detecting adapted to determine if the received power is within a predetermined interval, wherein any received relative scheduling grant not detected as unreliable is reliable;
means for interpreting (12) any detected unreliable relative scheduling grant as HOLD;
means for estimating (13) a new serving grant based at least on the detection and the interpretation, said means for estimating (13) adapted to follow commands of reliable relative scheduling grants and to treat unreliable relative scheduling grants as HOLD.

14. The arrangement according to claim 13, **characterized by** further means for reporting (14) an event to a serving unit in said telecommunication network on continuously received unreliable scheduling grants during a given period of time.

15. The arrangement according to claim 13, **characterized by** further means for receiving uplink interference thresholds for neighboring cells in a neighboring cells list; and said receiving means are adapted to in response to at least one detected unreliable received scheduling grant:

measuring the path loss to the neighboring cell and estimating UL interference, and
adjusting transmit power using the TFC selection to keep the interference below the uplink interference threshold.

16. The arrangement according to any of claims 13 to 15, **characterized by** further means for receiving UL TPC commands from a base station; and said interpreting means (12) are adapted to interpret the at least one unreliable received grant based on the received UL TPC commands.

Patentansprüche

1. Verfahren in einer Benutzereinrichtung in einem Telekommunikationsnetz zur Handhabung von unzuverlässigen relativen Dispositionsbewilligungen von relativen Dispositionsbewilligungen, die einen von einem HOLD-Befehl, einem UP-Befehl und einem

DOWN-Befehl umfassen, der bei einem von einer Einzelstrecke und einem Szenario sanfter Weiterschaltung angewendet werden kann, wobei das Verfahren **gekennzeichnet ist durch**:

Erkennen (S1) mindestens einer unzuverlässigen empfangenen relativen Dispositionsbewilligung, umfassend ein Bestimmen, ob die Empfangsleistung innerhalb eines vorbestimmten Intervalls ist, wobei jede empfangene relative Dispositionsbewilligung, die nicht als unzuverlässig erkannt wird, zuverlässig ist;
Interpretieren (S2) jeder erkannten unzuverlässigen relativen Dispositionsbewilligung als HOLD;
Schätzen (S3) einer neuen Versorgungsbewilligung mindestens auf der Basis der Erkennung und der Interpretation, wobei das Schätzen (S3) ein Anpassen der Versorgungsbewilligung umfasst, indem Befehle von zuverlässigen relativen Dispositionsbewilligungen befolgt und unzuverlässige relative Dispositionsbewilligungen als HOLD behandelt werden.

2. Verfahren nach Anspruch 1, **gekennzeichnet durch** Melden (S4) eines Ereignisses an das Telekommunikationsnetz bei kontinuierlich empfangenen unzuverlässigen Dispositionsbewilligungen während eines bestimmten Zeitraums.

3. Verfahren nach Anspruch 2, **gekennzeichnet durch** Melden (S4) des Ereignisses, wenn eine vorbestimmte Anzahl von unzuverlässigen Dispositionsbewilligungen während des bestimmten Zeitraums empfangen wurde.

4. Verfahren nach Anspruch 1, **gekennzeichnet durch** die weiteren Schritte der Benutzereinrichtung des Empfangens von Uplink-Interferenzschwellen für Nachbarzellen in einer Nachbarzellenliste; und in Reaktion auf mindestens eine erkannte unzuverlässige empfangene Dispositionsbewilligung:

Messen des Pfadverlusts zur Nachbarzelle und Schätzen von UL-Interferenz, und
Anpassen von Sendeleistung unter Verwendung der TFC-Auswahl, um die Interferenz unter der Uplink-Interferenzschwelle zu halten.

5. Verfahren nach einem der Ansprüche 1 bis 3, **gekennzeichnet durch** Empfangen von UL-TPC-Befehlen von einer Basisstation und Interpretieren (S2) der mindestens einen unzuverlässigen empfangenen Bewilligung basierend auf den empfangenen UL-TPC-Befehlen.

6. Verfahren nach Anspruch 5, **gekennzeichnet durch** Interpretieren (S2) einer unzuverlässigen empfangenen Dispositionsbewilligung als HOLD, wenn der UL-TPC-Befehl DOWN ist, wobei die Benutzereinrichtung die Bewilligung von der versorgenden Zelle befolgen kann.

7. Verfahren nach Anspruch 5, **gekennzeichnet durch** Interpretieren (S2) einer unzuverlässigen empfangenen Dispositionsbewilligung als DOWN, wenn der UL-TPC-Befehl UP ist.

8. Verfahren nach Anspruch 5, **gekennzeichnet durch** Interpretieren (S2) der mindestens einen unzuverlässigen empfangenen Dispositionsbewilligung gemäß

$$R_g = -1 \times TPC_{UL_TTI}$$

wobei R_g = interpretierte unzuverlässige Bewilligung, und TPCUL = 1 für UP-Befehl und TPCUL = 0 für DOWN-Befehl. TPC_{UL_TTI} basiert auf den kombinierten Entscheidungen aller TPC_{UL}-Befehle, die während eines TTIs (2 ms oder 10 ms) empfangen werden, z. B. ist dann, wenn TPC_{UL} mehrheitlich UP ist, TPC_{UL_TTI} UP, und umgekehrt.

9. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** das vorbestimmte Intervall ein unzuverlässiger Leistungsbereich ist.

10. Verfahren nach Anspruch 9, **dadurch gekennzeichnet, dass** der unzuverlässige Bereich durch einen ersten und einen zweiten Schwellenwert definiert ist.

11. Verfahren nach einem der vorhergehenden Ansprüche, **gekennzeichnet durch** Erkennen einer Mehrzahl von unzuverlässigen empfangenen Dispositionsbewilligungen.

12. Verfahren nach einem der Ansprüche 1 bis 11, **gekennzeichnet durch** Erkennen nur einer unzuverlässigen empfangenen Dispositionsbewilligung.

13. Anordnung in einer Benutzereinrichtung in einem Telekommunikationsnetz zur Handhabung von unzuverlässigen relativen Dispositionsbewilligungen von relativen Dispositionsbewilligungen, die einen von einem HOLD-Befehl, einem UP-Befehl und einem DOWN-Befehl umfassen, der bei einem von einer Einzelstrecke und einem Szenario sanfter Weiterschaltung angewendet werden kann, **gekennzeichnet durch**:

Mittel zum Erkennen (11) mindestens einer unzuverlässigen empfangenen Dispositionsbewilligung, wobei das Mittel zum Erkennen so aus-

gelegt ist, dass es bestimmt, ob die Empfangsleistung innerhalb eines vorbestimmten Intervalls ist, wobei jede empfangene relative Dispositionsbewilligung, die nicht als unzuverlässig erkannt wird, zuverlässig ist;
Mittel zum Interpretieren (12) jeder erkannten unzuverlässigen relativen Dispositionsbewilligung als HOLD;
Mittel zum Schätzen (13) einer neuen Versorgungsbewilligung mindestens auf der Basis der Erkennung und der Interpretation, wobei die Mittel zum Schätzen (13) so ausgelegt sind, dass sie Befehle von zuverlässigen relativen Versorgungsbewilligungen befolgen und unzuverlässige relative Dispositionsbewilligungen als HOLD behandeln.

14. Anordnung nach Anspruch 13, **gekennzeichnet durch** weitere Mittel zum Melden (14) eines Ereignisses an eine versorgende Einheit im Telekommunikationsnetz bei kontinuierlich empfangenen unzuverlässigen Dispositionsbewilligungen während eines bestimmten Zeitraums.

15. Anordnung nach Anspruch 13, **gekennzeichnet durch** weitere Mittel zum Empfangen von Uplink-Interferenzschwellen für Nachbarzellen in einer Nachbarzellenliste; und wobei die Empfangsmittel so ausgelegt sind, dass sie in Reaktion auf mindestens eine erkannte unzuverlässige empfangene Dispositionsbewilligung
den Pfadverlust zur Nachbarzelle messen und UL-Interferenz schätzen, und
Sendeleistung unter Verwendung der TFC-Auswahl anpassen, um die Interferenz unter der Uplink-Interferenzschwelle zu halten.

16. Anordnung nach einem der Ansprüche 13 bis 15, **gekennzeichnet durch** weitere Mittel zum Empfangen von UL-TPC-Befehlen von einer Basisstation; und wobei die Interpretationsmittel (12) so ausgelegt sind, dass sie die mindestens eine unzuverlässige empfangene Bewilligung basierend auf den empfangenen UL-TPC-Befehlen interpretieren.

Revendications

1. Procédé, dans un équipement utilisateur dans un réseau de télécommunications, destiné à effectuer la gestion d'octrois d'ordonnancement relatif non fiables parmi des octrois d'ordonnancement relatif comprenant l'une d'une commande HOLD, une commande UP et une commande DOWN applicable dans l'un d'une liaison unique et un scénario de transfert intercellulaire souple, le procédé étant **caractérisé par** :

la détection (S1) d'au moins un octroi d'ordonnancement relatif reçu non fiable comprenant la détermination si la puissance reçue est à l'intérieur d'un intervalle prédéterminé, dans lequel tout octroi d'ordonnancement relatif reçu non détecté en tant que non fiable est fiable ;
l'interprétation (S2) de tout octroi d'ordonnancement relatif non fiable détecté en tant que HOLD ;
l'estimation (S3) d'un nouvel octroi de desserte sur la base au moins de la détection et de l'interprétation, l'estimation (S3) comprenant l'adaptation de l'octroi de desserte en suivant des commandes d'octrois d'ordonnancement relatif fiables et en traitant des octrois d'ordonnancement relatif non fiables en tant que HOLD.

2. Procédé selon la revendication 1, **caractérisé par** le rapport (S4) d'un événement au dit réseau de télécommunications sur des octrois d'ordonnancement non fiables reçus continuellement au cours d'une période de temps donnée.

3. Procédé selon la revendication 2, **caractérisé par** le rapport (S4) de l'événement si un nombre prédéterminé d'octrois d'ordonnancement non fiables ont été reçus au cours de la période de temps donnée.

4. Procédé selon la revendication 1, **caractérisé en outre par** les étapes de la réception, par l'équipement utilisateur, de seuils d'interférence de liaison montante pour des cellules voisines dans une liste de cellules voisines ; et, en réponse à au moins un octroi d'ordonnancement reçu non fiable détecté :

la mesure de l'affaiblissement de propagation vers la cellule voisine et l'estimation d'une interférence de liaison montante, UL, et
l'ajustement d'une puissance d'émission en utilisant la sélection de TFC pour maintenir l'interférence au-dessous du seuil d'interférence de liaison montante.

5. Procédé selon l'une quelconque des revendications 1 à 3, **caractérisé par** la réception de commandes UL TPC en provenance d'une station de base et l'interprétation (S2) de l'au moins un octroi reçu non fiable sur la base des commandes UL TPC reçues.

6. Procédé selon la revendication 5, **caractérisé par** l'interprétation (S2) d'un octroi d'ordonnancement reçu non fiable en tant que HOLD si la commande UL TPC est DOWN, de telle manière que l'équipement utilisateur puisse suivre l'octroi à partir de la cellule de desserte.

7. Procédé selon la revendication 5, **caractérisé par** l'interprétation (S2) d'un octroi d'ordonnancement

reçu non fiable en tant que DOWN si la commande UL TPC est UP.

8. Procédé selon la revendication 5, **caractérisé par** l'interprétation (S2) dudit au moins un octroi d'ordonnancement reçu non fiable en fonction de :

$$R_g = -1xTPC_{UL_TTI}$$

où R_g = octroi non fiable interprété, et TPCUL=1 pour une commande UP et TPCUL=0 pour une commande DOWN. TPC_{UL_TTI} est basé sur les décisions combinées de toutes les commandes TPC_{UL} reçues au cours d'un TTI (2 ms ou 10 ms), par exemple si les TPC_{UL} sont majoritairement UP, alors TPC_{UL_TTI} est UP et vice versa.

9. Procédé selon la revendication 1, **caractérisé en ce que** ledit intervalle prédéterminé est une région de puissance non fiable.

10. Procédé selon la revendication 9, **caractérisé en ce que** ladite région non fiable est définie par des première et deuxième valeurs de seuil.

11. Procédé selon l'une quelconque des revendications précédentes, **caractérisé par** la détection d'une pluralité d'octrois d'ordonnancement reçus non fiables.

12. Procédé selon l'une quelconque des revendications 1 à 11, **caractérisé par** la détection d'un seul octroi d'ordonnancement reçu non fiable.

13. Agencement, dans un équipement utilisateur dans un réseau de télécommunications, destiné à effectuer la gestion d'octrois d'ordonnancement relatif non fiables parmi des octrois d'ordonnancement relatif comprenant l'une d'une commande HOLD, une commande UP et une commande DOWN applicable dans l'un d'une liaison unique et un scénario de transfert intercellulaire souple, **caractérisé par** :

des moyens de détection (11) d'au moins un octroi d'ordonnancement reçu non fiable, lesdits moyens de détection étant aptes à effectuer la détermination si la puissance reçue est à l'intérieur d'un intervalle prédéterminé, dans lequel tout octroi d'ordonnancement relatif reçu non détecté en tant que non fiable est fiable ;
des moyens d'interprétation (12) de tout octroi d'ordonnancement relatif non fiable détecté en tant que HOLD ;
des moyens d'estimation (13) d'un nouvel octroi de desserte sur la base au moins de la détection et de l'interprétation, lesdits moyens d'estimation (13) étant aptes à suivre des commandes d'octrois d'ordonnancement relatif fiables et à traiter des octrois d'ordonnancement relatif non fiables en tant que HOLD.

14. Agencement selon la revendication 13, **caractérisé en outre en ce qu'**il comprend des moyens pour effectuer le rapport (14) d'un événement à une unité de desserte dans ledit réseau de télécommunications sur des octrois d'ordonnancement non fiables reçus continuellement au cours d'une période de temps donnée.

15. Agencement selon la revendication 13, **caractérisé en outre en ce qu'**il comprend des moyens pour effectuer la réception de seuils d'interférence de liaison montante pour des cellules voisines dans une liste de cellules voisines ; et lesdits moyens de réception sont aptes à effectuer, en réponse à au moins un octroi d'ordonnancement reçu non fiable détecté :

la mesure de l'affaiblissement de propagation vers la cellule voisine et l'estimation d'une interférence de liaison montante, UL, et
l'ajustement d'une puissance d'émission en utilisant la sélection de TFC pour maintenir l'interférence au-dessous du seuil d'interférence de liaison montante.

16. Agencement selon l'une quelconque des revendications 13 à 15, **caractérisé en ce qu'**il comprend en outre des moyens pour effectuer la réception de commandes UL TPC en provenance d'une station de base ; et lesdits moyens d'interprétation (12) sont aptes à effectuer l'interprétation de l'au moins un octroi reçu non fiable sur la base des commandes UL TPC reçues.

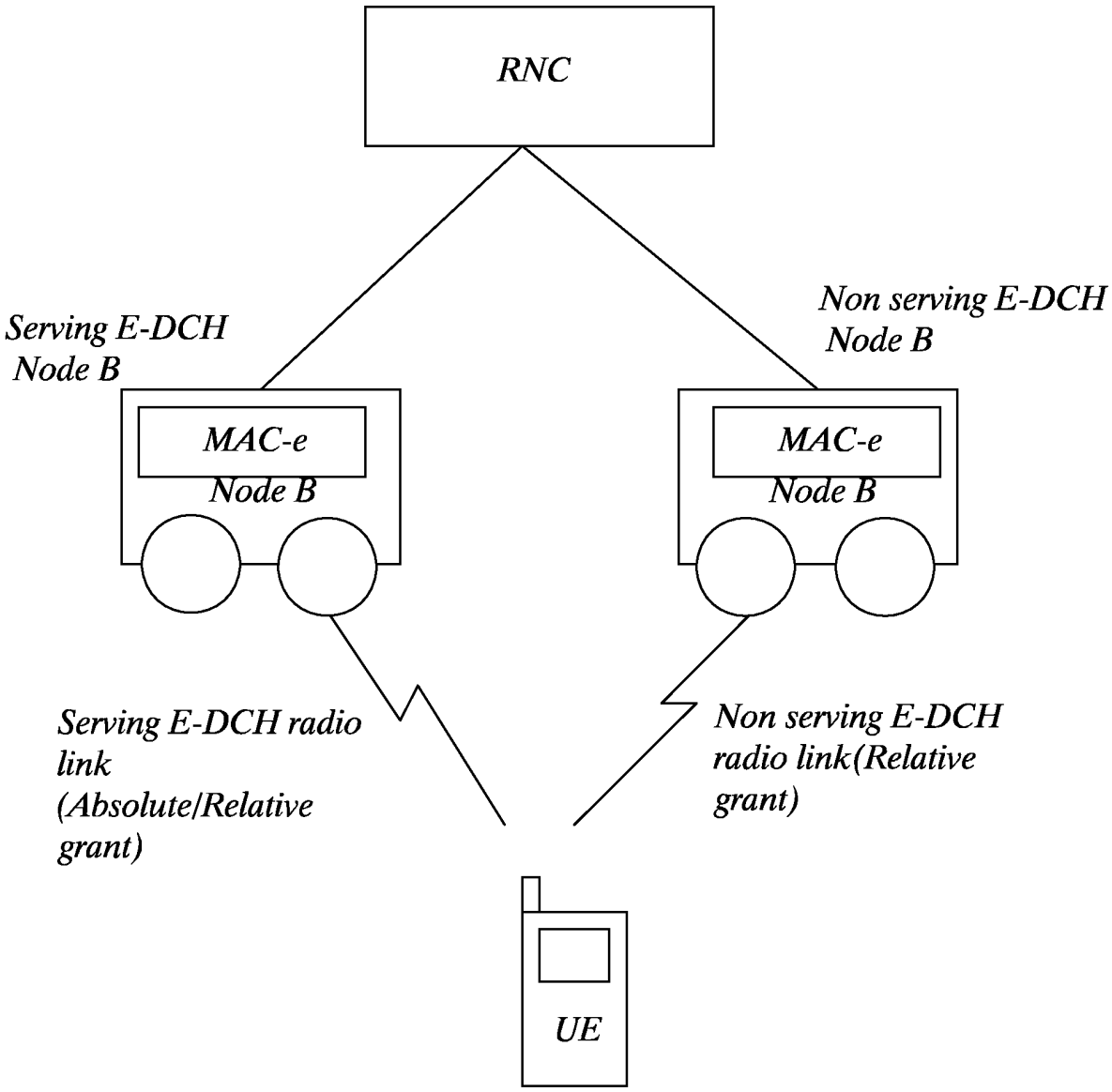

RNC
Serving E-DCH Node B
Non serving E-DCH Node B
MAC-e
Node B
MAC-e
Node B
Serving E-DCH radio link (Absolute/Relative grant)
Non serving E-DCH radio link(Relative grant)
UE

FIG. 1

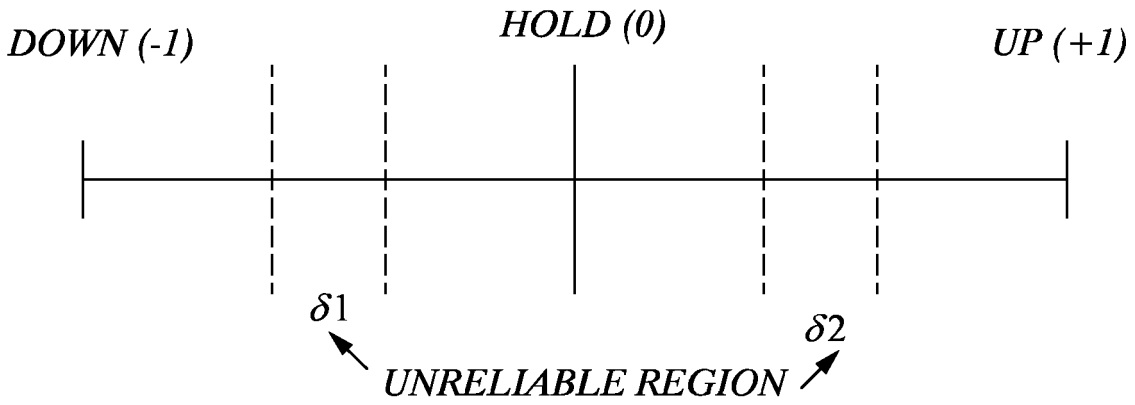


FIG. 2

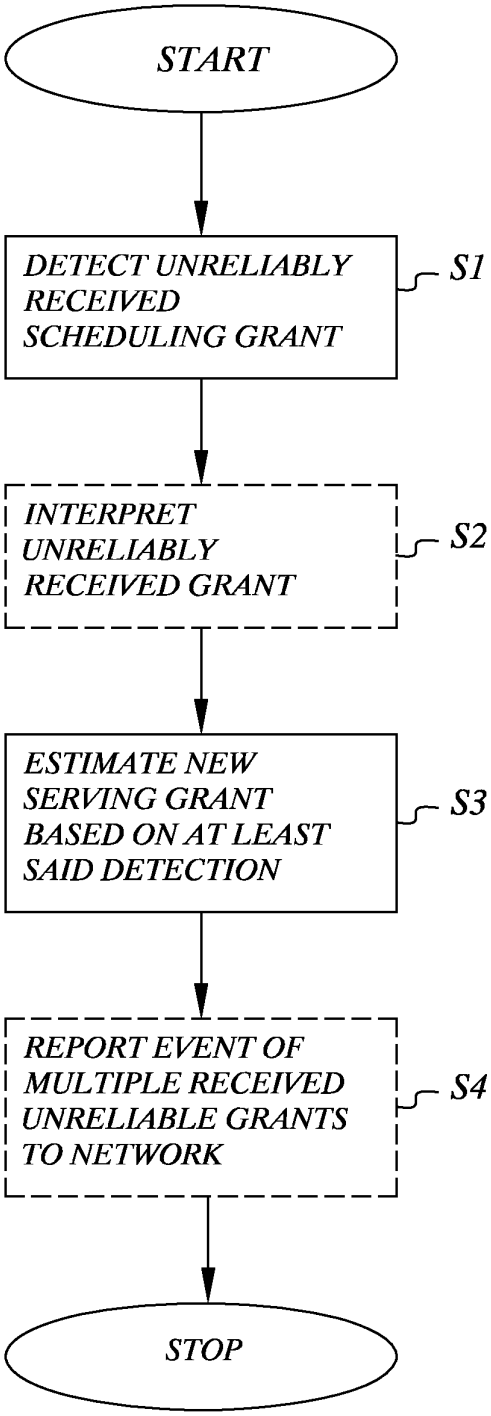

START
DETECT UNRELIABLY RECEIVED SCHEDULING GRANT
S1
INTERPRET UNRELIABLY RECEIVED GRANT
S2
ESTIMATE NEW SERVING GRANT BASED ON AT LEAST SAID DETECTION
S3
REPORT EVENT OF MULTIPLE RECEIVED UNRELIABLE GRANTS TO NETWORK
S4
STOP

FIG. 3

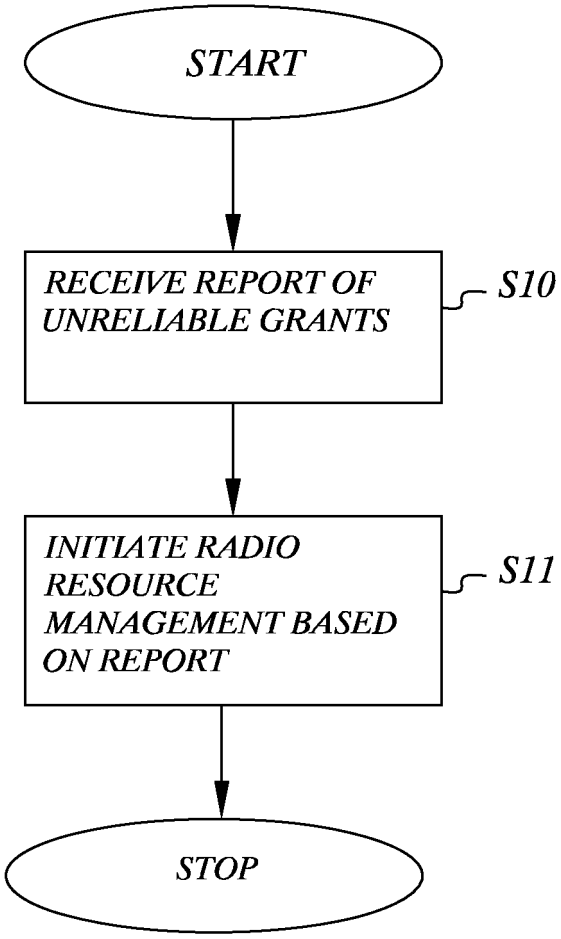

START
RECEIVE REPORT OF UNRELIABLE GRANTS
S10
INITIATE RADIO RESOURCE MANAGEMENT BASED ON REPORT
S11
STOP

FIG. 4

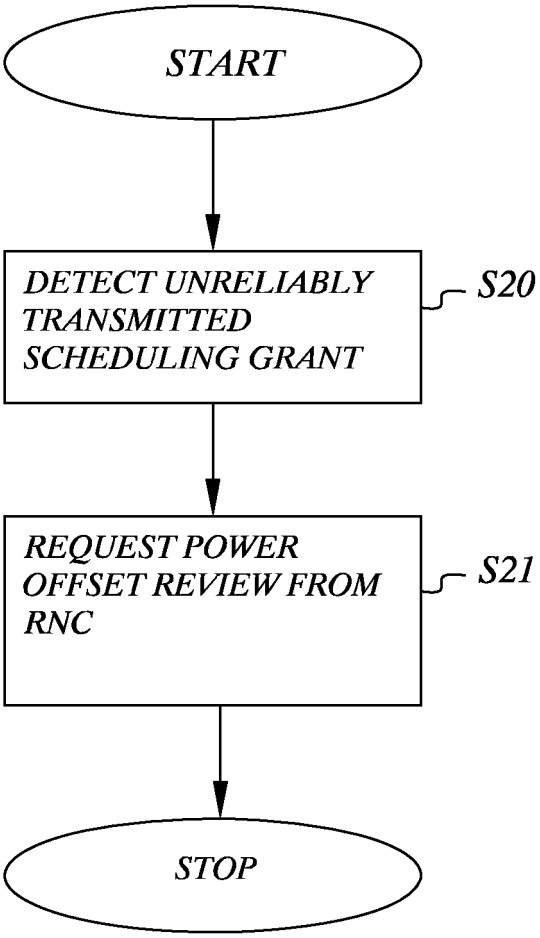

START
DETECT UNRELIABLY TRANSMITTED SCHEDULING GRANT
S20
REQUEST POWER OFFSET REVIEW FROM RNC
S21
STOP

FIG. 5

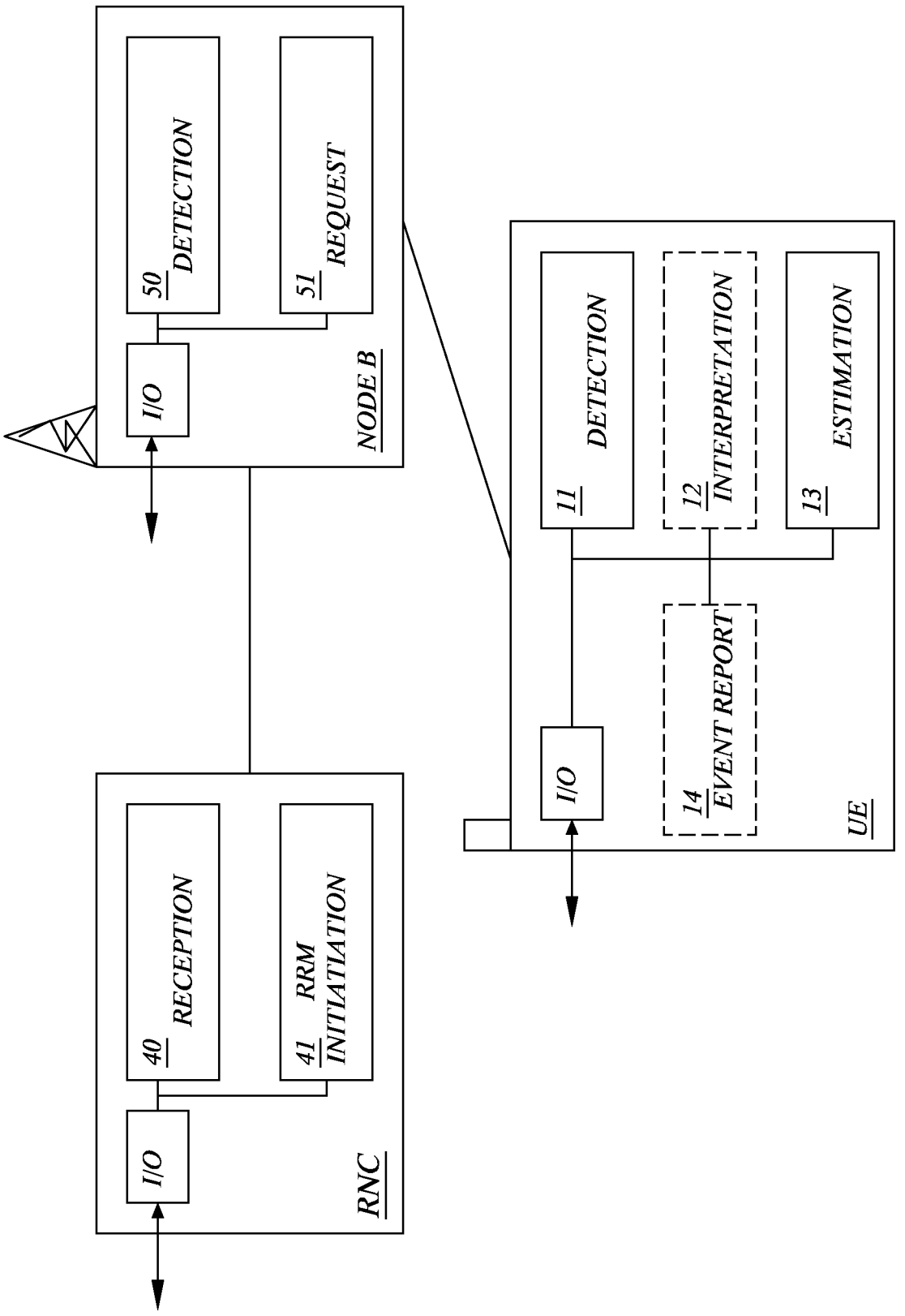

NODE B
I/O
50 DETECTION
51 REQUEST
RNC
I/O
40 RECEPTION
41 RRM INITIATION
UE
I/O
11 DETECTION
12 INTERPRETATION
13 ESTIMATION
14 EVENT REPORT

FIG. 6

REFERENCES CITED IN THE DESCRIPTION

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